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Kootenai River Fisheries Investigation: Stock Status of Burbot and Rainbow Trout and Fisheries Inventory

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KOOTENAI RIVER FISHERIES INVESTIGATION: STOCK STATUS OF BURBOT AND RAINBOW TROUT AND FISHERIES INVENTORY

ANNUAL REPORT 1993

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ABSTRACT

Seventeen burbot Lota Iota were caught in the Kootenai River with two sizes of hoop nets baited with fish. One burbot was a recapture. Burbot catch from March 19 through May 10, 1993 averaged 0.03 fish/net/day. Total length ranged from 367 to 701 mm and weight from 369 to 2,610 g (mean = 916 g). Nearly all burbot were caught at Ambush Rock. Preliminary findings are that burbot abundance in the Kootenai River is substantially less than it was in the late 1970s. Rainbow trout Oncorhynchus mykiss and seven other species of fish were sampled in tributary streams of the Kootenai River. A single pass was made with a backpack electroshocker. Species diversity ranged from two found in Cascade Creek to eight each in Snow and Caribou creeks. Most streams were partially channelized in their lower reaches, and these segments were lower in species richness. Sculpins Cottus sp. were often the only species found in channelized segments. Trout were caught in all streams. Rainbow trout were the most abundant salmonid. Cutthroat trout O. clarki numbers were highest in Cascade Creek. I estimated a total of 5,268 anglers fished 13,698 h (± 3,913), for 129 h/km (± 36), from March through August 1993. Fisherman averaged 2.6 h/trip based on completed trip information. The estimated total angler catch was 5,937 fish (± 3,395), of which 3,676 (± 3,246) were kept. Angler effort for 1993 was similar to that of 1982. Angler harvest of rainbow trout was estimated at 700 fish (± 873) and they averaged 276 mm total length. Mean catch rate for anglers fishing for rainbow trout was about 0.02 fish/h. Rainbow trout comprised 17% of the catch. Angler harvest of cutthroat trout was 105 fish (± 118) at less than 0.01 fish/h and averaged 356 mm total length.

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INTRODUCTION

The geologic history of the Kootenai River system can be traced back to the Wisconsin Glacier and glacial Lake Kootenay (Alden 1953). Colonization of the river with a variety of fish species is thought to have occurred during this period (Northcote 1973). Many changes have occurred since then.

The Kootenai River, Kootenay Lake, and tributaries (Figure 1) of the drainage provided important fisheries to native Americans since the earliest known records and, more recently, European settlers (Northcote 1973). The Kootenai River in Idaho provides two unique fisheries to the state. The Kootenai River is the lair of the only known endemic population of burbot Lota lota in Idaho (Simpson and Wallace 1982) and a genetically distinct population of white sturgeon Acipenser transmontanus (Setter and Brannon 1990). Local newspaper archives provide photographs and stories of once popular fisheries for burbot, trout Oncorhynchus spp., and sturgeon. The best records of fishing activity in the Idaho portion of the Kootenai River were recorded by Partridge (1983). Partridge documented angling effort of 102 h/km in 1982, with 82% (74 h/km) of the effort for salmonids. The catch rate for trout Oncorhvnchus app. was 0.06 fish/h. Burbot and sturgeon fishing activity comprised 18% of the total effort. Cooperating anglers fishing for burbot in 1981 reported fishing a total of 9,045 h and caught 179 burbot (0.02 fish/h) (Partridge 1983). Fishing activity on the Montana portion of the river was reported to be substantially higher at 1,662 h/km.

The natural conditions of the Kootenai River no longer exist. Logging and mining operations as early as the 1880s caused tributary discharge to flash and physically changed the streams and caused siltation (Northcote 1973)'. Additional disturbances came to the drainage in 1892 with attempts to dike the lower reach of the river and claim land for agricultural uses (Northcote 1973). Mining added to the deterioration of the water quality in the tributaries and river, and from 1953 through the 1970s, operation of a fertilizer plant on the St Mary River added to the nutrient levels (Northcote 1973).

Disturbance of the Kootenai River ecosystem was heightened by the construction and operation of Libby Dam and impoundment of Lake Koocanusa. Libby Dam was created under an International Columbia River Treaty between the United States and Canada for cooperative water management of the Columbia River Basin (Columbia River Treaty 1964). Construction of the dam began in 1966 by the Army Corps of Engineers. Its main purpose is hydropower production, with secondary benefits of flood control and navigation. Impoundment of Lake Koocanusa and regulation of downstream flows began in March of 1972. After completion of the dam, mean monthly flows downstream during spring were reduced by 50%, and winter flows tripled (Figure 2). Temperature also increased by 3°C (Partridge 1983). Under the present operation, the river now remains ice-free during the winter. Prior to the dam, the river froze over in many portions of the Idaho reach. Turbidity and nutrient loads in the Kootenai River have also changed because the impoundment acts as a nutrient and sediment trap (May and Huston 1979).

Concern for the Kootenai River fisheries in the late 1970s prompted a research investigation by the Idaho Department of Fish and Game (IDFG) (Partridge 1983). This study emphasized an inventory of the river fisheries and learning more about the environmental aggravation to the white sturgeon, burbot, rainbow trout, mountain whitefish Prosopium williamsoni, and cutthroat trout. Partridge found regulation of springtime discharge was the probable cause of poor recruitment of young sturgeon, the burbot population was on the decline from pre-dam abundance, the winter burbot fishery was nearly eliminated because of water management from the dam, and the trout population was low, and spawning and rearing habitat was limiting.

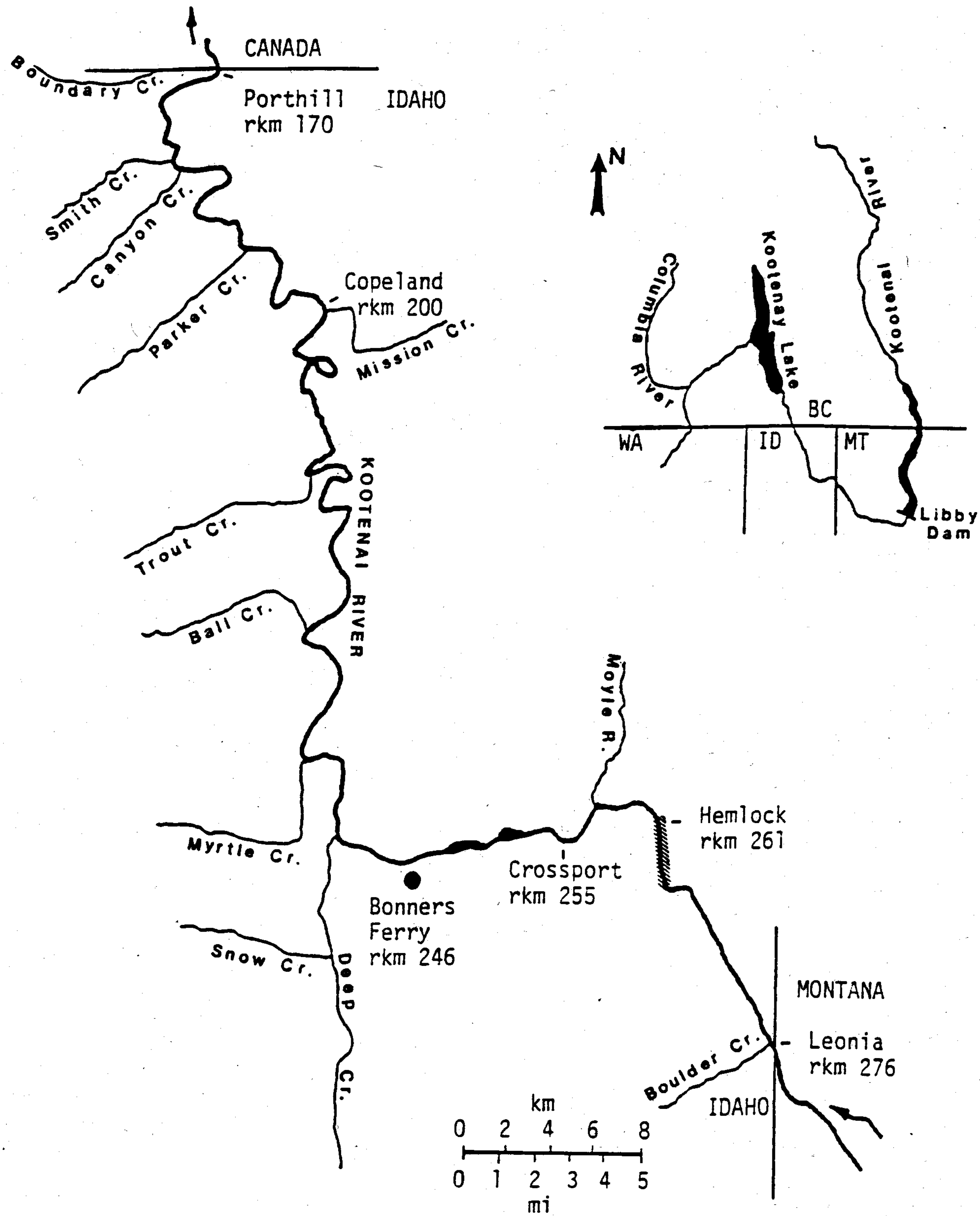


Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributaries in Idaho. The river distances in Figure 1 are in kilometers (rkm) and are indicated at important access points. The Hemlock Bar is indicated by the cross-hatched area at rkm 261.

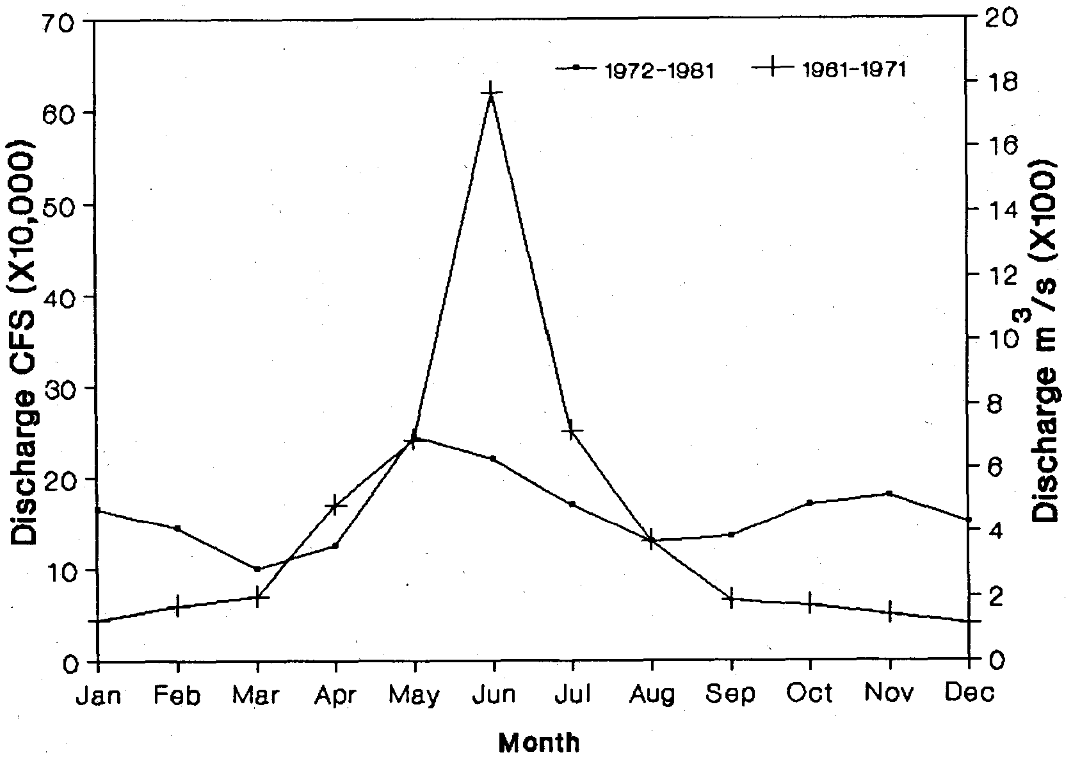


Figure 2. Mean monthly discharge of the Kootenai River at Porthill, Idaho, from 1961 through 1971 (pre-Libby Dam) and from 1972 through 1981 (post-Libby Dam). Figure adopted from Partridge (1983).

The Pacific Northwest Power Act of 1980 recognized possible conflicts resulting from hydropower development in the northwest and directed the Bonneville Power Administration (BPA) to "protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of any hydropower projects in the Columbia River system." Under this Act, the Northwest Power Planning Council was created, and federally-funded investigations were designed to help offset the loss of natural resources.

This investigation was designed as a follow-up to the efforts of Partridge (1983) and a companion study to the present white sturgeon investigation (Apperson 1992). However, until now the needs of burbot, a species of "special concern," and, the trout populations have not been identified. This investigation is an inventory study and is intended to identify factors limiting burbot and trout populations to provide management alternatives to restore and achieve fisheries management (Idaho Department of Fish and Game 1992 Fisheries Management Plan).

STUDY AREA

The Kootenai River is in the upper Columbia River drainage, 'it is the second largest tributary, and originates in Kootenay National Park, British Columbia (Figure 1). The river traverses south into Montana, but Libby Dam impounds water back into Canada forming Lake Koocanusa. From Libby Dam, the river turns west, then northwest into Idaho, then north into British Columbia and Kootenay Lake. Kootenai River at Porthill, Idaho drains about 35,490 km^2, and the reach in Idaho is 106 km long. Kootenay Lake drains out the West Arm, and eventually the river joins with the Columbia River near Castlegar, British Columbia.

The Kootenai River presents two different channel and habitat types while it passes through Idaho. As the river enters Idaho, it is typified by its steep canyon walls and high gradient (0.6 m/km), but at about river kilometer 255, upstream of Bonners Ferry, the river changes to a lower gradient (0.02 m/km) meandering river with a broad flood plain. Tributary streams of the Kootenai River are typically high gradient while the pass through mountain canyons, but revert to lower gradients when they reach the valley floor. Most of these tributary streams have been channelized at their lower reach and leveed to accommodate the levees that follow the border of the river.

GOAL

To restore the burbot and rainbow trout populations in the Idaho reach of the Kootenai River and improve fishing success to historic levels.

OBJECTIVES

1. To identify factors that are limiting populations of burbot, rainbow trout, and other populations within the Idaho portion of the Kootenai River drainage, and recommend management alternatives to restore the fisheries to self-sustainable levels.

2. Determine if the burbot population is being limited by reproductive success, survival, and/or the recruitment of young burbot.

METHODS

Sampling Burbot

I sampled burbot in the Kootenai River with two sizes of hoop nets. The large nets were 3.66 m long with fiberglass hoops and polyvinyl chloride spreader bars 3.06 m in length (Bernard et al. 1991). The hoops had an inside diameter of 91 cm and tapered to 69 cm toward the cod end. Each net had a double throat that narrowed to an opening of about 19 cm. Netting was nylon woven into 25 mm bar mesh and had number 15 cotton twine. The smaller hoop nets were 3.05 m long and had an entrance diameter of 61 cm tapering to 46 cm toward the cod end. Web and hardware of the smaller nets were the same as the larger nets. All nets were anchored at the cod end with a 10 kg concrete weight, and an orange buoy was tied to the first hoop with a length of rope to mark and raise the net. I placed chunks of cut fish into woven bait bags and suspended it from the second to last hoop (from the entrance) inside the net. Kokanee *Oncorhynchus nerka*, northern squawfish, *Ptychocheilus oregonensis*, or suckers *Catostomus* sp. were used as bait.

I fished 9 to 13 hoop nets continuously from March 10 through June 10, 1993 on the Kootenai River for a total of 570 net days (a net day is a single 24 h set). These nets were set from the Idaho-Montana border at Leona (273 rkm) to near Copeland (225 rkm) (Figure 1). Nets were initially set within 2 km of Deep Creek, then progressively moved in groups of four or five upstream, then downstream. However, four to five nets were fished continuously in the vicinity of Ambush Rock (245 rkm). Nets were set with the aid of a Lowrance X16 graph recorder to help ensure the opening of the net was on the river bottom. I checked the nets every 24 to 72 h with the aid of Department personnel or a volunteer. I recorded the depth, substrate type (sand, gravel, cobble, or boulder), and the location (main channel, main channel border, outside bend, or inside bend) of the individual net sets.

Fish captured in the hoop nets were identified, enumerated, measured in total length, weighed individually, and released. Some suckers and northern squawfish were used to re-bait the net. Burbot sampled in 1993 had one-half of the right pectoral fin clipped and were marked with a sequentially numbered Floy anchor tag.

Sampling Tributary Streams for Trout

Rainbow trout and other species of fish were sampled in tributary streams of the Kootenai River with a model 11-A Smith Root back Pack electroshocker (Figure 1). A single run sample was taken from the mouth (wadeable water) to the first fish barrier of each stream. All fish were identified, enumerated, measured (total length), weighed, and then released. Scales were taken from some trout for age analysis. Catch/unit of effort was calculated by recording the elapsed time of electrofishing for each stream. The streams were measured, and length and mean width of each stream reach was used to calculate surface area and relative one-pass catch/100 m^2. The single pass was considered to represent a minimum estimate of density.

Angler Effort and Harvest

A stratified random creel survey was conducted during the 1993 fishing season to provide estimates of angling effort, catch, and harvest. The 1993 survey incorporated a computer-generated program (McArthur 1991) which provided all calculations and randomly chose a creel interview calendar.

The creel season was temporally stratified by month to reduce variability and provide catch comparisons. Creel information was collected from March 1 and is expected to extend through February 1994.

The Kootenai River was stratified into three segments and was non-uniform in design to reduce variability due to differences in access and fishing activity. Reach one extended from the Idaho-Montana border downstream to the Highway 95 bridge at Bonners Ferry; reach two was from the Highway 95 bridge to Copeland; and reach three was from Copeland to the Idaho-Canada border. For the purpose of this report, I have combined the data for all sections of the river. Creel data was collected by one creel clerk that interviewed anglers at access sites and occasionally by boat. Access sites were randomly chosen, as was the designation to creel reach one, two, or three. Four weekend days and eight week-days were worked each month at eight hours per day. Each day was divided into two randomly-chosen four-hour time periods. Information was taken from completed and incomplete angling trips.

Instantaneous angler counts were made periodically by jet boat to determine the fishing pressure for weekend days and week days.

Creel survey data were expanded by river section and day type (weekend days and week days) to estimate harvest, catch, and effort (hours and angler-days) for each month. The data included in this report is incomplete because it only includes the March through August summary.

RESULTS

Hoop Net Sampling

Total Catch

I fished hoop nets during the spring of 1993 for a total of 570 net days in the Kootenai River. I caught a total of 139 fish, of which 50% were longnose suckers Catostomus catostomus and largescale suckers C. macrocheilus, 26% northern squawfish, and 12% burbot, while the remainder was comprised of mountain whitefish, peamouth Mvlocheilus caurinus, rainbow and bull trout O. confluentus and one white sturgeon (Table 1). The total catch per unit of effort (CPUE) for all fish was 0.244 fish/net/day, with longnose sucker as the highest at a CPUE of 0.09 fish/net/day. The total weight of my catch was 263.3 kg (Table 1).

Burbot

I caught a total of 17 burbot, of which 1 was a **recapture.** The **CPUE for** burbot from March 19 through May 10, **1993** was 0.03 fish/net/day. These fish ranged from 367 to 701 mm (Figure 3) and weighed from 369 to 2,610 g (x= 916 g).

Most burbot were caught at the base of Ambush Rock (244 rkm), while one fish was caught just above the confluence of the Moyie and Kootenai Rivers (260 rkm). Fish caught at Ambush Rock were caught at depths ranging from 3 to 20 m and in association with boulder-cobble substrate. The fish caught upstream of the Moyie River was in 3 m of water with boulder-cobble substrate. All fish were captured at an outside bend.

Table 1. Hoop net catch success by number, weight (kg), and catch per unit Effort[a] (CPUE), Kootenai River, Idaho, March 19 through May 15, 1993.

Species	Number	Total Weight	CPUE.
White sturgeon	1	66.0	0.002
Bull trout	2	3.1	0.003
Rainbow trout	2	2.4	0.003
Mountain whitefish	6	1.2	0.011
Longnose sucker	52	25.5	0.092
Largescale sucker	19	9.4	0.033
Northern squawfish	36	139.4	0.063
Burbot	17	15.6	0.030
Total	135	262.6	0.237

[a]A unit of effort is a single 24-hour set.

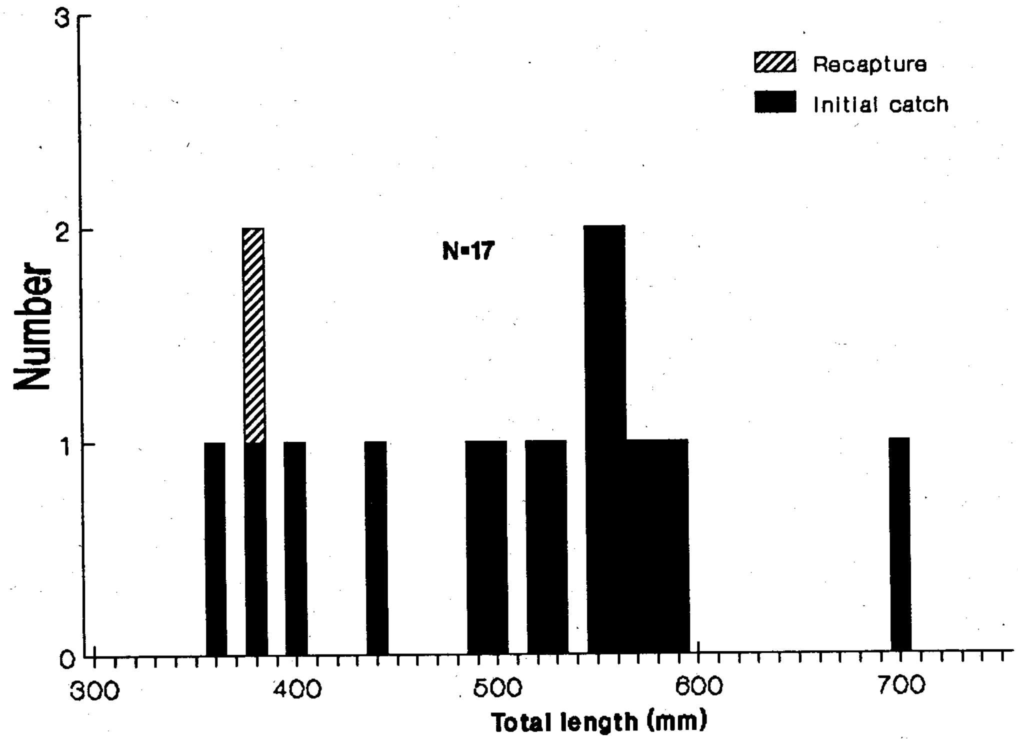


Figure 3. Length frequency distribution of burbot caught by baited hoop nets in the Kootenai River, Idaho, March through May 1993.

Sampling of Tributary Streams

Stream Dimensions

We sampled 11 tributary streams with single-pass electrofishing during the 1993 sampling period (Table 2). The length of the stream reach sampled, from the mouth to the first fish barrier, ranged from 274 m for Cascade Creek to 1,860 m for Smith Creek (Table 2). Surface area for sampled reaches ranged from 0.045 hectares for Cascade Creek to 3.4 hectares for Smith Creek.

Electrofishing Catch

We sampled eight species of fish including rainbow trout, cutthroat trout, bull trout, longnose dace *Rhinichthys cataractae*, slimy sculpin *Cottus cognatus*, torrent sculpin *C. rhotheus*, and mountain whitefish (Appendix A). Total catch ranged from 55 fish in Smith Creek to 367 in Trout Creek (Appendix A). Diversity ranged from two species found in Cascade Creek to eight species found in Snow and Caribou creeks. Most streams were channelized, and these segments were low in species richness, with sculpins often the only species found.

Trout Abundance

Trout were caught in all streams, but minimum densities within natural stream reaches ranged from less than 0,01 trout/100 m^2 for Smith Creek to 16 trout/100 m^2 in Cascade Creek (Table 3). Rainbow trout were the most abundant salmonid, ranging as high as 12 trout/100 m^2 for Cascade Creek. Cutthroat trout densities were as high as 4 trout/100 m^2 also for Cascade Creek. Direct comparison of density estimates should be used with caution since efficiency of our single-pass electrofishing at the various sites is unknown.

In addition, scale analysis indicated that most trout caught in Snow, Caribou, Long Canyon, Ball, and Trout creeks were age 0 and age 1, whereas fish in Cascade Creek were of a 'stunted' population up to age 3 (Figure 4). Fish densities were also calculated for the channelized reach (Table 3) and as fish/1,000 m for the natural and channelized reach (Appendix B). No burbot were collected in any of the tributaries surveyed.

The Fishery

Total Catch and Effort

The 1993 creel survey for the Kootenai River was incomplete at the time this report was prepared; these are preliminary results. However, this report does contain information pertaining to angler effort, catch, and catch success for March through August 1993.

Creel clerks interviewed 99 anglers during a 6-month period. A total of 77 instantaneous angler counts were made. Game fish catch included rainbow trout, cutthroat trout, whitefish, and white sturgeon. Catch of non-sport fish was comprised primarily of northern squawfish, peamouth, and suckers.

Table 2. Length, mean width, and area of tributaries to the Kootenai River Idaho, that were sampled in 1993. stream section identifies the natural reach (A), the channelized reach (B), and total length sampled (C).

Stream	Section	Length (m)	Mean width (m)	Area (m^2)	Area (hectares)
Myrtle Creek	A	761.2	8.3	6,289.4	0.629
Myrtle Creek	B	840.0	9.4	7,921.2	0.792
Myrtle Creek	C	601.2	8.9	14,210.6	1.421
Long Canyon Creek	A	293.5	7.4	2,174.8	0.217
Long Canyon Creek	B	906.7	10.4	9,438.7	0.943
Long Canyon Creek	C	1,200.2	9.7	11,613.5	1.161
Burton Creek	A	300.0	3.6	1,080.0	0.108
Burton Creek	B	135.0	5.4	729.0	0.073
Burton Creek	C	435.0	4.2	1,809.0	0.181
Smith Creek	A	600.0	11.3	6,763.2	0.673
Smith Creek	B	1,260.0	16.5	20,756.2	2.756
Smith Creek	C	1,860.0	14.8	27,519.4	3.429
Cascade Creek	A'	274.4	1.6	451.2	0.045
Ball Creek	A	645.0	8.1	5,236.8	0.524
Ball Creek	B	176.7	9.2	1,625.6	0.163
Ball Creek	C	821.7	8.4	6,862.4	0.682
Caribou Creek	A	475	6.4	3,040.0	0.304
Caribou Creek	B	480	6.8	3,264.0	0.326
Caribou Creek	C	955	6.6	6,304.0	0.630

Table 2. Continued.

Stream	Section	Length (m)	Mean width (m)	Area (m^2)	Area (hectares)
Snow Creek	A[a]	1,079	7.7	8,307.5	0.831
Grass Creek	A[a]	356	10.7	3,819.8	0.382
Parker Creek	A	176	6.2	1,091.2	0.109
Parker Creek	B	750	6.1	4,575.0	0.458
Parker Creek	C	926	6.1	5,666.2	0.567
Trout Creek	A[a]	1,477	3.3	4,895.6	0.490

[a]Entire length sampled was a natural reach.

Table 3. Single run electrofish catch per 100 m^2 in natural stream reaches of 11 tributaries of the Kootenai River, Idaho, July through August 1993. The catch per 100 m^2 in the channelized reach is subtended. Comparisons between streams should be used with caution since efficiency of electrofishing capture is unknown.

	Mountain whitefish	Rainbow trout	Cutthroat trout	Hybrid[a]	Brook trout	Bull trout	Longnose dace	Sculpin[b]
Snow Creek	.04	.60	.11	0	.02	.01	.53	.76
Caribou Creek	.06	.30	.06	0	.13	.03	.33	.56
	(0)	(0)	(.09)	(0)	(0)	(0)	(.25)	(.25)
Parker Creek	0	.37	0	0	2.39	0	.18	2.11
	(0)	(0)	(0)	(0)	(.31)	(0)	(.22)	(.92)
Myrtle Creek	.02	.02	0	0	.11	0	.38	.30
	(0)	(0)	(0)	(0)	(.25)	0	(.39)	(.35)
Long Canyon Creek	0	.23	0	0	.11	0	.88	1.61
	(0)	(0)	(0)	(0)	(.25)	0	(.06)	(.74)
Smith Creek[c]	.01	.01	0	0	0	0	.24	(.55)
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(.03)
Cascade Creek	0	11.56	3.56	.44	0	0	0	0
Ball Creek	.06	.31	.27	0	.06	0	.10	3.63
	(0)	(0)	(0)	(0)	(6)	(0)	(6)	(74)
Trout Creek	.08	.10	.39	0	5.29	0	.20	.72
Burton Creek	.09	.09	.83	0	2.13	0	.56	6.50
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2.1)
Grass Creek	0	.25	.18	0	.02	0	0	0

[a] Hybrid rainbow and cutthroat trout.

[b] Includes slimy sculpin (*Cottus coanatus*) and torrent sculpin (C. *rhotheus*).

[c] The channelized reach of Smith Creek was difficult to sample with backpack electrofishing gear because of the depth.

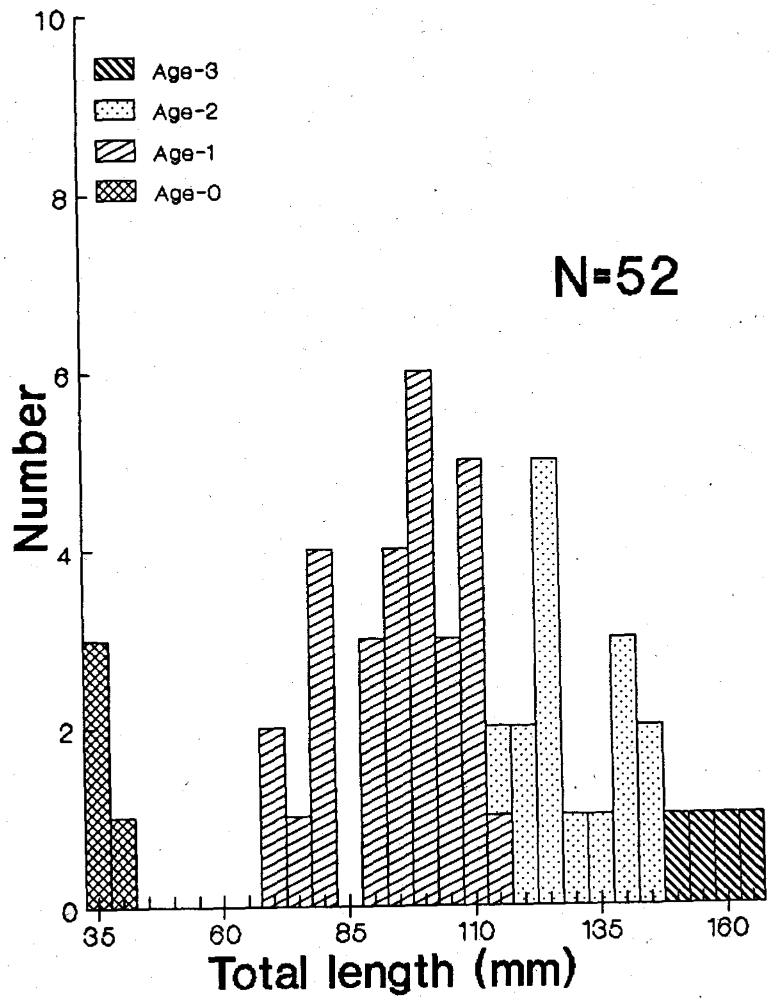


Figure 4. Length frequency distribution of four age classes of rainbow trout sampled in Cascade Creek, 1993.

A total of 5,268 anglers fished 13,698 h (± 3,913), or 129 h/km (± 36), from March through August 1993. Fisherman averaged 2.6 h per trip. The estimated total angler catch was 5,937 fish (± 3,395), of which 3,676 (± 3,246) were kept. Over 90% of the anglers were residents. Bank anglers comprised 52% of the fisherman, while the remainder fished from boats.

Trout and Mountain Whitefish Harvest

The angler harvest of rainbow trout was 700 fish (± 873) for the six months of creel, and they averaged 276 mm total length. Mean catch rate for anglers fishing for rainbow trout was about 0.02 fish/h. Rainbow trout comprised 17% of the catch. I estimated the angler harvest of cutthroat trout at about 105 fish (± 118), and catch success was less than 0.01 fish/h for the 6-month period. Cutthroat trout averaged 356 mm total length. The creel clerk did not see any bull trout in the creel, but three anglers reported catching at least one during the 6-month interval.

I found mountain whitefish were the most abundant sport fish in the creel, comprising 37% of the catch. Anglers harvested 1,052 fish (± 907) for a catch rate of about 0.02 fish/h, and they averaged 299 mm total length.

Burbot and White Sturgeon Catch and Release

None of the anglers interviewed by creel clerks had caught a burbot, nor were there any reports of burbot being caught. Creel clerks interviewed three anglers that had fished for white sturgeon and they caught one fish at <0.01 fish/h.

Non-sport Fish

I estimated the catch of non-sport fish at 2,574 fish, of which 38% were peamouth, 35% northern squawfish, and 27% were suckers. The peamouth averaged 226 mm total length, northern squawfish averaged 457 mm total length, and the suckers averaged 375 mm total length.

DISCUSSION

Burbot Population Status, 1993

I caught only 17 burbot in 570 net days (CPUE of 0.03) from March through May 1993 (Figure 3). With such a low catch, it is difficult to address missing year classes, but the catch from 1993 is much lower than what Partridge (1983) found. My electrofishing efforts in tributary streams in 1993 failed to show any young burbot, whereas Partridge (1983) captured several. Trout streams are not uncommon as nursery areas for young burbot (Harlan and Speaker 1956).

Historic Status of Burbot

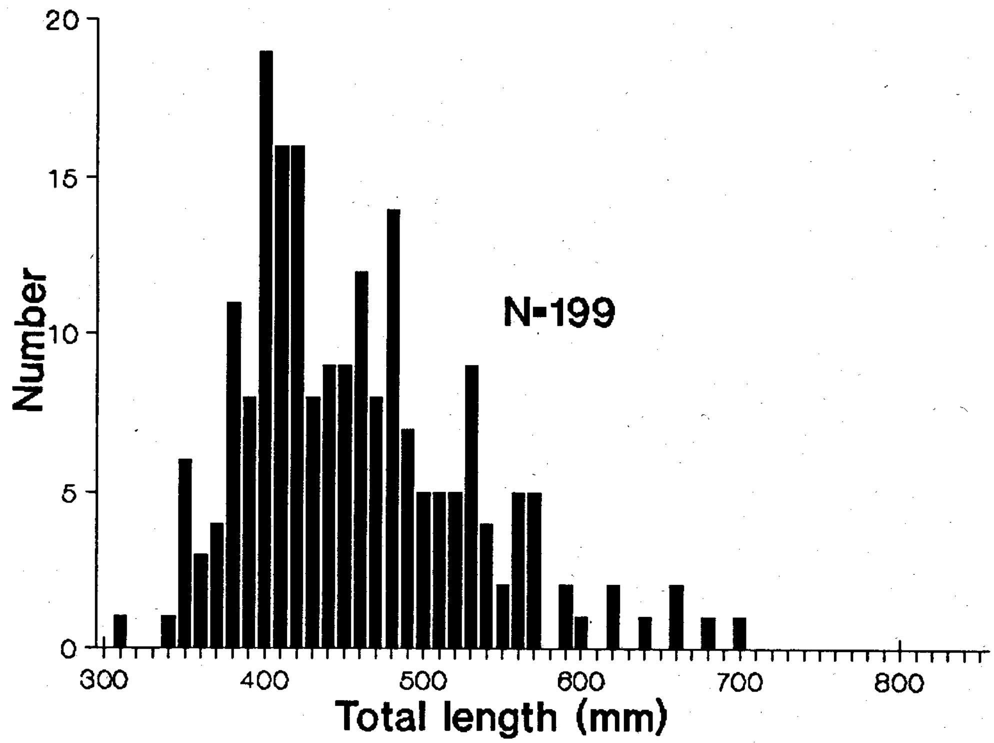
The earliest records of burbot sampling in the Kootenai River in Idaho (Partridge 1983) were taken from the IDFG Panhandle Region archives. They indicated Department personnel caught 199 burbot in a 2-year period of sampling, 1957 and 1958 (Figure 5). The length frequency distribution demonstrates an abundance of young fish 350 to 500 mm total length and a good representation of older fish. Partridge (1983) captured a total of 108 burbot with three different gears from 1979 through 1982 (Figure 5). He found fewer fish, and in 1979 he caught only 8 fish in 129 net days (0.06 fish/net/day) "with a similar amount of effort" used to catch burbot in 1957 and 1958. Although all age groups vulnerable to sampling gear appear to be present in Partridges' catch, Partridge believed the abundance was substantially less than that of the late 1950s because many more fish were caught with a "similar amount of effort."

I identified three possible factors or combinations for the decline of burbot in the Kootenai River. They are overexploitation, temperature and flow changes that may have altered spawning behavior, and poor fry survival because of a reduction in productivity (food production) of the river.

I talked to local burbot anglers, asked about their fishing experiences, and reviewed IDFG archives. Antidotal information indicated an excellent winter fishery was present from the 1950s through the early 1970s. Anglers reported catching many burbot through the ice on set lines. Warmer water temperatures because of the outflow from Libby Dam eliminated the winter ice fishing (Partridge 1983). Spearing of burbot on spawning runs in tributaries like Snow, Caribou, and Deep creeks accounted for many fish, and there was no Departmental limit to the harvest of burbot. Some anglers reported filling gunny sacks with fish. It was believed that many of these burbot were from Kootenay Lake, British Columbia (Partridge 1983). Burbot regulations in Idaho were unrestrictive until 1983 when a two-fish limit was adopted this was followed in 1992 by a closure of the take of burbot. The burbot harvest from 1979 through 1982 was estimated at less than 250 fish/year.

I also examined the archives of the British Columbia Ministry of Environment fisheries records in Nelson, British Columbia for the same time frame as the change in the fishery in Idaho. Management of burbot in Kootenay Lake was also liberal, with a limit of 15 fish as late as the late 1960s, but in 1967, the limit was lowered to 12 (Sinclair and Crowley 1969). Burbot were very concentrated in the Balfour area of the west arm of Kootenay Lake, and thus very vulnerable to angling. The concentration of burbot on the locally known "ling beds" perhaps was due to either the abundance of mysids used as food and/or a spawning site (Andrusak and Crowley 1978). However, eggs or young-of-the-year burbot have never been seen in the lake (Les Fleck, British Columbia Ministry of Environment, personal communication). But, over 25,000 burbot were caught in 1969 and about 20,000 in 1971 (Figure 6). The angling catch rate of burbot averaged about 1 fish/h during this same period (Figure 6). The harvest of burbot declined substantially in the following years, and the limit was reduced to 10/day in 1975 (Andrusak 1974). The need to implement more restrictive management was apparent (Andrusak and Crowley 1976), and a potential production and harvest investigation was undertaken (Martin 1976). The findings of the investigation (Martin 1976) indicated an optimum sustainable yield of about 12,000 burbot at 14,560 rod hours would sustain the fishery. The limit of burbot was reduced to 5 fish/day since about 1976 and still remains. However, the harvest of burbot continued to decline through the 1970s, although angling catch success remained at about 0.7 fish/h (Figure 6). The burbot fishery collapsed, and as of 1987 no fish have been recorded in the fishery at Balfour,- British Columbia. Without the knowledge of environmental stresses to the burbot fishery, the assumption could be made that overexploitation led to the demise of the population. But we do not know for certain if the Kootenay Lake burbot was of the same population as that of the Kootenai River.

The history of the environmental degradation to the Kootenai River and the ecosystem is common knowledge (Northcote 1973, Cloern 1976, Daley et al 1981, and Partridge 1983). Mining and logging in the drainage has always been an



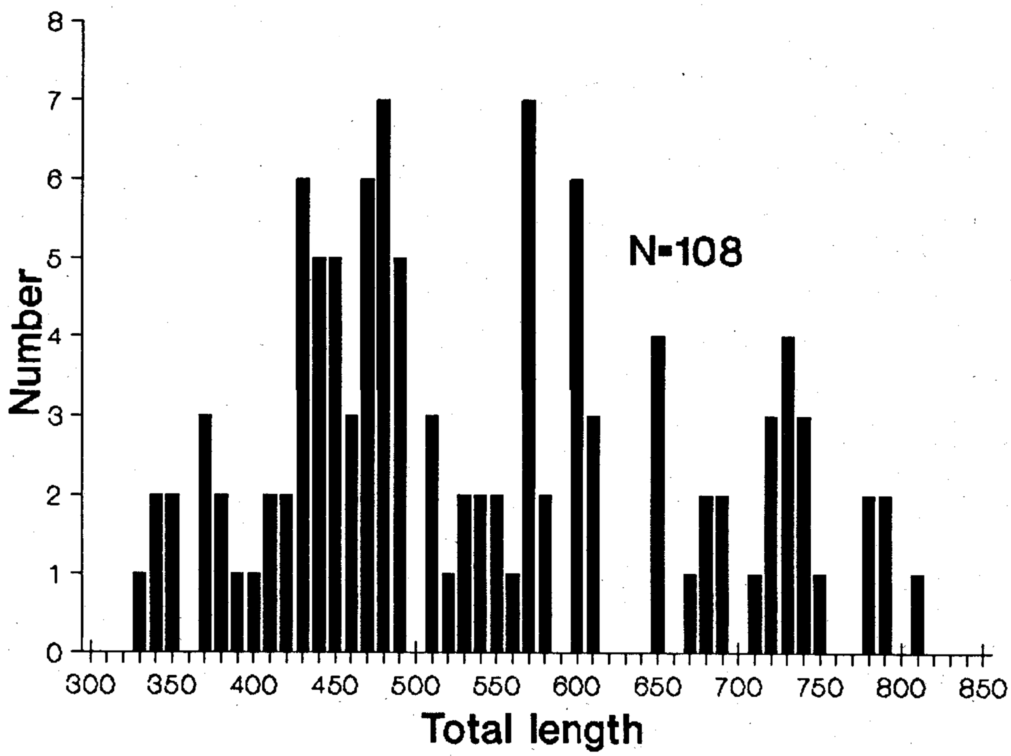


Figure 5. Length frequency distribution of burbot caught by baited hoop nets from 1957 through 1958 (top figure) and angling, set lines, and baited hoop nets from 1979 through 1982 (bottom figure) in the Kootenai River, Idaho.

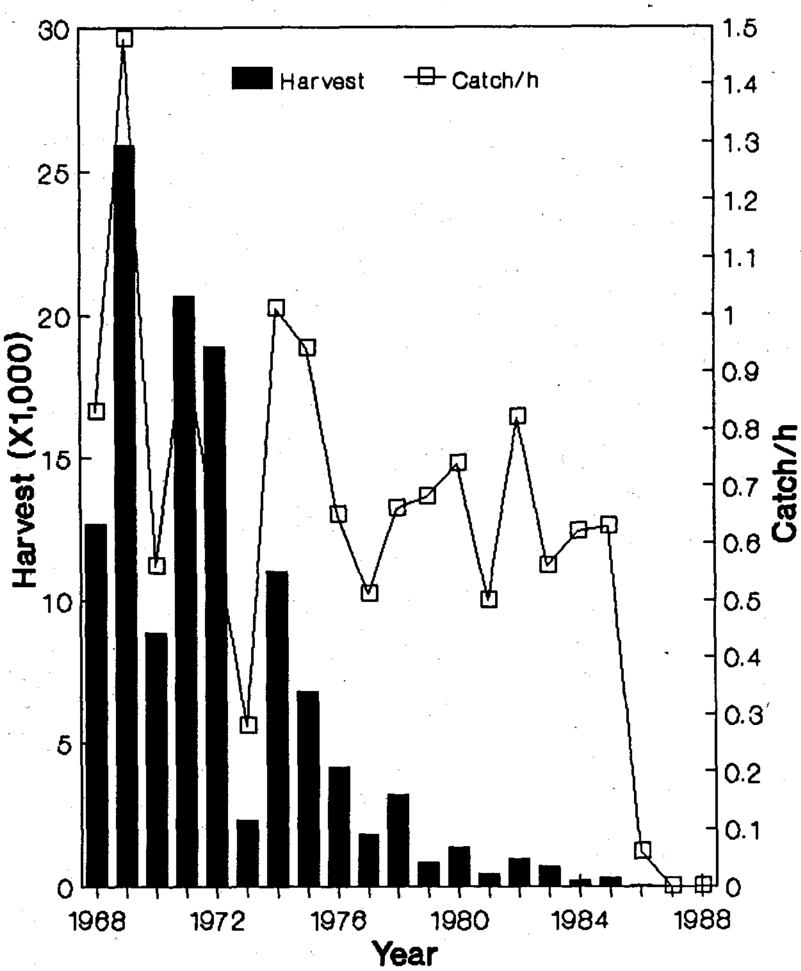


Figure 6. Sport fishing harvest and catch success (fish/h) of burbot in Kootenay Lake from 1968 through 1988.

environmental concern, particularly with the release of heavy metals and their toxicity (Partridge 1983). Artificial eutrophication because of a fertilizer plant on a tributary to the Kootenai River in British Columbia brought about an elevation in productivity, particularly in Kootenay Lake (Northcote 1973). Pollution abatement in the mid-1970s (Jay Hammond, British Columbia, Ministry of Environment, personal communication) and the impoundment of water and consequential settling of sediment and nutrients at Lake Koocanusa reduced the nutrient load of the river (Daily et al. 1981). The reduced productivity (lower food abundance), regulation of the river, loss of riparian and backwater areas have also been the speculation of the loss of burbot, as well as white sturgeon (Partridge 1983). Larval burbot can be pelagic (Faber 1970) and feed on a variety of micro and macroorganisms in the water column, including rotifers, copepod nauplii, copepods, and cladocerans (Ghan and Sprules 1993). If food is limiting, reduced food abundance could equate to lower survival of young burbot.

I also considered the possible consequences of post-dam changes in winter flow and temperature of the Kootenai River. Inspection of a pre- and post-dam hydrograph (Figure 2) and temperature regime of the river (Partridge 1983) presents several suspect changes that could be damaging to the burbot population. Burbot are winter spawners and often spawn under the ice in January through March (Becker 1983). Prior to the dam, the Kootenai River froze frequently during these months. Burbot spawn at about 1.5°C, or near freezing temperatures (Becker 1983 and McKay 1963). Since 1974, the winter river temperatures are now 3-4°C as opposed to the pre-dam years of near 1°C and less. The winter hydrograph has also changed. The former natural discharge during January-February slowly increased to a peak spring freshette in June from melting snow in the mountains. At present, average discharge is higher during September to February than before the dam. One hypothesis is the river no longer provides an adequate increase in discharge and cooling temperatures to stimulate spawning.

Perhaps a contrast to the Kootenai River burbot population may be the burbot fishery in Lake Michigan. The burbot fishery in Lake Michigan was on the brink of extirpation because of predation by the invading sea lamprey Petromvzon marinus (Smith 1968, Wells and McLain 1973). After development of a selective toxicant for sea lamprey and control of this parasite, the burbot population rebounded without stocking, and their commercial landings increased almost five-fold (Fratt 1991). The source of predation was controlled, but there were no .reported changes in the environment. Thus, the resiliency of the burbot in Lake Michigan enabled this stock to rebound when habitat was unaltered, whereas the burbot population in the ecologically disturbed Kootenai River has not improved despite closure of fishing in Idaho and greater fishing restrictions in British Columbia.

Kootenai River Burbot Stock

Burbot are still plentiful in Lake Koocanusa, Montana, the impoundment created by Libby Dam (Don Skarr, Montana Department of Fish, Wildlife, and Parks, personal Communication). Burbot were also captured in the Kootenai River, at 0.13 fish/net/day in 1992 and 0.07 fish/net/day in 1993, in the Montana reach of the river below Kootenai Falls (Don Skarr, Montana Department of Fish, Wildlife, and Parks, personal communication). These burbot probably immigrate into Idaho waters, but they can be identified because they were marked prior to release with a hole punched in a fin.

I do not know if burbot that I sampled in the Kootenai River are residents, emigrants from Lake Koocanusa, Montana, a potamodromous stock from Kootenay Lake, or any combination. Continued inspection of burbot for marked fins, identifying them as fish from Montana waters, and sonic telemetry from this study should provide helpful information to determine the origin of fish in Idaho. However, my limited catch distribution of burbot during the spring 1993 sampling may provide some clues. Nearly all of the burbot that I caught were in the upper reach of the Idaho portion of the Kootenai River At Ambush Rock in habitat typical for burbot (Becker 1983, Edsall et al. 1993). Partridge (1983) caught burbot throughout the length of the Kootenai River in Idaho without mention of habitat preferences or a unique distribution pattern. His tag recoveries inferred that burbot moved freely through the Idaho portion of river, and some burbot moved into Canadian waters. It may be possible the fish that I have now captured are immigrants from Lake Koocanusa. Also, I caught burbot in habitat similar to the burbot habitat documented in Montana; large boulders, cobble, modest current velocity, and 3 to 10 m depth. Burbot observed by divers In Kootenay Lake were found over sandy substrate (Memo from C. Ball to British Columbia Environment Fisheries Biologists, 42-032, June 5, 1972). None of the burbot that I caught were on sandy substrate despite the fact many net days were also fished on this substrate.

Instream flow studies are scheduled for the Kootenai River in Idaho for the 1995 field season. I also plan on implanting sonic transmitters into adult burbot in the autumn of 1993 and carry this work through 1995. The sonic telemetry will provide information as to habitat preferences and spawning locations of burbot in Idaho. These studies will illustrate habitat use for all life stages of burbot as well as rainbow trout.

Trout and Tributary Streams

We sampled 11 streams of the 22 streams inventoried by Partridge (1983). However, comparison of our electrofishing catch to that of Partridge cannot be made since he did not calculate CPUE, and the efficiency of our gear compared to his may have differed. The single-pass total catch of Partridge (1983) and ours suggests little difference in the relative abundance of trout in nursery streams to the Kootenai River in Idaho. These comparisons are based on a single-pass catch. Population estimates with confidence intervals should be made for valid determination of abundance.

Few adult trout are year-long residents of the tributaries we sampled in 1993. Researchers captured only one adult trout during the stream inventory work of 1993; a 320 mm bull trout in Snow Creek. The exception is the population of rainbow trout in Cascade Creek. Partridge (1983) found few adults in his inventory work, but reported runs of adult trout into the tributaries in Idaho were smaller than those reported by May et al. (1981) for tributaries in Montana.

Most barriers in tributaries are natural, but the one on Cascade Creek is a man-made structure that is tentatively scheduled for change as part of mitigation to a proposed small-scale hydropower project. This project has been pending for many years and likely will not be completed for many more to come. Improvement in the structure on this stream could make Cascade Creek available as a trout spawning and nursery stream to the Kootenai River.

Channelized reaches of streams in the Kootenai River drainage were low in species diversity and. provided cover to only a few trout. This fact was not unexpected and was similar to the findings of Partridge (1983). Many of the channelized reaches were occupied only by sculpins and a few longnose dace. In some circumstances, young-of-the-year brook trout were caught at stream margins where some bank cover was available. The environmental damage to stream habitats by channelization has been the finding of many studies (Schneberger and Funk 1971).

I will continue the inventory of the primary trout nursery streams during the 1994 field season. Included will be mark and recapture or depletion population estimates of trout in all of the primary trout nursery streams. Also, population estimates will be made in the Kootenai River of trout and whitefish, and estimates of growth and condition during autumn 1993 and 1994. The latter population estimates will be done at the reach of the Kootenai River known as the "Hemlock Bar" (Figure 1). Some of these data will be used to compare the present status of trout in nursery streams and the river to those reported by Partridge (1983) during the early 1980s. From these comparisons, I will formulate recommendations to management of the river for trout.

The Fishery

Our findings indicate fishing activity on the Kootenai River has changed little since 1982 and is less intense than some river fisheries in the Panhandle Region. The 1993 creel through August covered a similar time span as that of Partridge (1983); January through August 1982. We estimated an angling effort of 13,698 h at 129 h/km (± 36), while Partridge (1983) estimated an effort of 102 h/km. Anglers fishing the North Fork of the Coeur d'Alene River and the Little North Fork of the Coeur d'Alene River fished 17,147 h and 2,585 h, respectively, in 1992 (Davis and Horner 1993). These two streams are small bodies of water by contrast to the larger Kootenai River. On the other hand, a 19.4 km reach of the Spokane River had 6,193 h of effort in 1990 (Davis 1991).

We documented a lower angling catch success for trout in the Kootenai River during 1993 as compared to 1982. Anglers fishing for trout caught 0.03 trout/h in 1993, whereas the catch was 0.06 trout/h in 1983 (Partridge 1983). Anglers fishing the Spokane River in 1990 had substantially better fishing success at 0.3 trout/h (Davis 1991), while anglers fishing the North Fork of the Coeur d'Alene River and the Little North Fork of the Coeur d'Alene River in 1992 caught 0.73 and 0.67 trout/h (Davis and Horner 1993). It should be noted, a substantial portion of the catch from these streams were hatchery releases.

The rainbow trout is still the most popular trout and, although the harvest from the Kootenai River was estimated at 700 fish, compared to 448 in 1982 (Partridge 1983), the confidence interval was very high at ± 873 fish, and there was no significant difference. The broad confidence interval is probably due to the fact so few fishermen were interviewed. This seasonal estimate will change, as will the confidence interval, since the creel survey will continue and the most important portion of the fishing season for trout may be during the autumn (Partridge 1982). At completion of the 1993 creel survey, a synopsis of trends in the rainbow trout fishery will be summarized in the next report.

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LITERATURE CITED

Alden, W.C. 1953. Physiography and glacial geology of western Montana and adjacent areas. U.S. Geological Survey Professional Paper 231. Helena.

Andrusak, H. 1974. Kootenay Lake sport fishery 1974-1976. British Columbia Ministry of Environment Fish and Wildlife Report. British Columbia, Canada.

Andrusak, H. 1976. Kootenay Lake sport fishery 1972-1973. British Columbia Ministry of Environment Fish and Wildlife Report. British Columbia, Canada.

Andrusak, H., and M.A. Crowley, 1978. Kootenay Lake sport fishery, 1974-1976. British Columbia Ministry of Environment Fish and Wildlife Report. British Columbia, Canada.

Apperson, K.A. 1991. Kootenai white sturgeon investigations and experimental culture. Idaho Department of Fish and Game, Annual Report to Bonneville Power Administration, Contract DE-AI79-88BP93497, Project 88-65. Boise.

Becker, G. 1983. Fishes of Wisconsin. The University of Wisconsin Press. Madison.

Bernard, D.R., G.A. Pearse, and R.H. Conrad. 1991. Hoop traps as a means to capture burbot. North American Journal of Fisheries Management. 11:91-104.

Cloern, J.E. 1976. Recent limnological changes in southern Kootenay Lake, British Columbia. Canadian Journal of Zoology 54:1571-1578.

Daley, R.J., E.C. Carmack, C.B. Gray, C.H. Pharo, S. Jasper, and R.C. Wiegland. 1981. The effects of upstream impoundments of Kootenay Lake, British Columbia, Canada Inland Waters Directorate, Research Institute, Scientific Series, British Columbia, Canada.

Davis, J.A. 1991. Region 1 Spokane River fishery evaluation. Regional Fishery Management Investigations. Idaho Department of Fish and Game, Annual Report, Project F-71-R-15, Boise.

Davis, J.A., and N. Horner. 1993. Region 1 Rivers and Streams Investigations: Coeur d'Alene River put-and-take rainbow evaluation. Regional Fishery management Investigations. Idaho Department of Fish and Game, Annual Report, Project F-71-R-17, Boise.

Edsall, T.A., G.W. Kennedy, and W.H. Horns. 1993. Distribution, abundance, and resting microhabitat of burbot on Julian's Reef, southwestern Lake Michigan. Transactions of the American Fisheries Society. 122:560-574.

Faber, D.J. 1970. Ecological observations of newly hatched lake whitefish in South Bay, Lake Huron. pp. 481-500 ij Biology of coregonid fishes, ed. C.C. Lindsey and C.S. Woods. University of Manitoba Press, Manitoba, Canada.

Fratt, T.W. 1991. Trophic ecology of burbot and lake trout in Green Bay and Lake Michigan with information for burbot on fecundity, gonadosomatic index, sea lamprey marks, and acanthocephalans. Masters Thesis, University of Wisconsin at Stevens Point.

Ghan, D., and W.G. Sprules. 1993. Diet, prey selection and growth of larval and juvenile burbot Lota Iota (L.). Journal of fish biology. 42, 47-64.

Harlan, J.R., and E.B. Speaker. 1956. Iowa fish and fishing. Iowa Conservation Commission. Des Moines.

Martin, A.D. 1976. Kootenay Lake burbot fishery. Miscellaneous student report provided to the British Columbia Ministry of Environment. British Columbia, Canada.

May, B., and J.. Huston. 1979. Kootenai River fisheries investigation. Montana Department of Fish, Wildlife, and Parks, Fisheries Division, Final Report. Helena.

May, B., S. Perry, and J.D. Ssantos. 1981. Kootenai River fisheries investigations. Montana Department of Fish, Wildlife, and Parks, Fisheries Division, Annual Progress Report, Helena.

MacKay, M.A. 1963. Fishes of Ontario. The Ontario Department of Lands and Forests. The Bryant Press Limited, Ontario, Canada.

McArthur, T.J. 1992. Creel Census System. Technical reference manual, Idaho Department of Fish and Game, Boise.

Northcote T.G. 1973. Some impacts of man on Kootenay Lake and its salmonids. Great Lakes Fishery Commission, Technical Report Number 25. Ann Arbor, Michigan.

Partridge, F. 1983. Kootenai River fisheries investigations. Idaho Department of Fish and Game. Job Completion Report. Project F-73-R-5, Boise.

Schneberger, E., and J.L. Funk. 1971. Stream channelization - a symposium. North Central Division of the American Fisheries Society, Special Publication Number 2. Bethesda, Maryland.

Setter, A., and E. Brannon. 1990. Report on Kootenai River white sturgeon electrophoretic studies – 1989 in Apperson, K.A. 1990. Kootenai River white sturgeon investigations and experimental culture. Idaho Department of Fish and Game, Annual Report to Bonneville Power Administration, Contract De-AI79-88BP93497, Project 88-65. Boise.

Simpson, J., and R. Wallace._ 1982. Fishes of Idaho. The University Press of Idaho. Moscow.

Sinclair, D.C., and M.A. Crowley, 1969. Kootenay Lake sport fishery, 1962-1968. British Columbia Ministry of Environment Fish and Wildlife Report. British Columbia, Canada.

Smith, S.H. 1968. Species succession and fishery exploitation in the Great Lakes. Journal of the Fisheries Research Board of Canada 25(4):667-693.

Wells, L., and A.L. McLain. 1973. Lake Michigan. Man's effects on native fish stocks and other biota. Great Lakes Fishery Commission Technical Report No. 20. Ann Arbor.

A P P E N D I C E S

Appendix A. Single run electrofishing catch from 11 tributaries of the Kootenai River, Idaho, July through August 1993.

		SPECIES								
Stream	Effort (Minutes)	Mountain whitefish	Rainbow trout	Cutthroat trout	Hybrid`	Brook trout	Bull trout	Longnose dace	Sculpin[b]	Total Catch
Snow Creek	328	3	50	9	0	12	1	44	63	182
Caribou Creek	263	2	9	5	0	4	1	18	25	64
Parker Creek	137	0	4	0	0	40	0	12	65	121
Myrtle Creek	205	1	1	0	0	27	0	55	47	131
Long Canyon Creek	173	0	5	0	0	6	0	35	105	151
Smith Creek	C88	1	1	0	0	0	0	16	37	55
Cascade Creek	74	0	52	16	2	0	0	0	0	70
Ball Creek	195	3	16	14	0	3	0	5	202	243
Trout Creek	210	4	5	19	0	257	0	10	72	367
Burton Creek	190	1	1	9	0	23	0	6	85	125
Grass Creek	180	0	21	15	0	2	0	0	0	38

[a]Hybrid rainbow and cutthroat trout.
[b]Includes slimy sculpin (*Cottus cognatus*) and the torrent sculpin (*C. rhotheus*).
[c]An additional 45 minutes of electrofishing the channelized reach resulted in a catch of eight sculpins.

Appendix B. Single run electrofishing catch per 1,000 m in natural. stream reaches of 11 tributaries of the Kootenai River, Idaho, July through August 1993. The catch per 1,000 m in the channelized reach is subtended.

	SPECIES							
Stream	Mountain whitefish	Rainbow trout	Cutthroat trout	Hybrid[a]	Brook trout	Bull trout	Longnose dace	Sculpin[b]
Snow Creek	3	46	8	0	11	1	41	58
Caribou Creek	4	19	4	0	8	2	21	118
	(0)	(0)	(6)	(0)	(0)	(0)	(17)	(17)
Parker Creek	0	23	0	0	147	0	11	130
	(0)	(0)	(0)	(0)	(19)	(0)	(13)	(56)
Myrtle Creek	1	1	0	0	9	0	21	25
	(0)	(0)	(0)	(0)	(24)	0	(37)	(33)
Long Canyon Creek	0	14	0	0	14	0	99	119
	(0)	(0)	(0)	(0)	(2)	(0)	(7)	(77)
Smith Creek	2	2	0	0	0	0	27	62
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(6)
Cascade Creek	0	190	58	7	0	0	0	0
Ball Creek	5	25	22	0	5	0	6	295
	(0)	(0)	(0)	(0)	(0)	(0)	(6)	(68)
Trout Creek	3	3	13	0	174	0	7	49
Burton Creek	3	3	13	0	77	0	20	233
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(111)
Grass Creek	0	59	42	0	6	0	0	0

[a]Hybrid rainbow and cutthroat trout.
[b]includes slimy sculpin (*Cottus cognatus*) and the torrent sculpin (*C. rhotheus*).

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